

SRC-W & SW series compressors

Electrical devices

(WA-05-08-E)

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5. Electrical motor

5.1 General

The electric motor is a 3-phase asynchronous 2-pole type (2900 rpm at 50 Hz). To reduce the starting current part winding and star delta versions are available:

Full size motor

In the standard delivery the motor is a part winding type (50/50); Star/Delta version is available on request.

The part winding motor version is a double delta type (Figure 1). There is one winding but the start configuration is different from the run configuration. From the point of view of the external wiring, there is no difference with the traditional double star part winding motors.

⇒ **Note: the wiring resistance between the start terminals (1-2-3) and the run terminals (7-8-9) is not infinite as with the double star motors.**

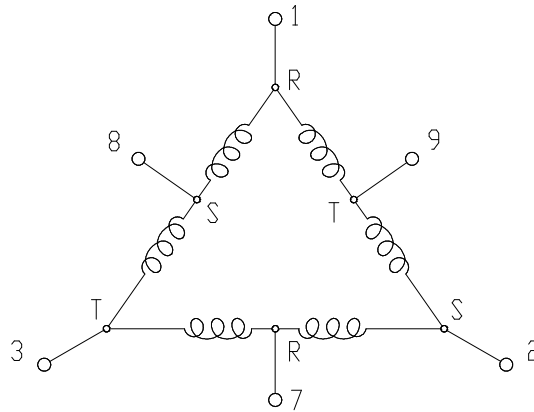


Figure 1: double delta motor

When a motor is started in part winding or star connection, the starting torque is lower. A reduction of the resisting torque is obtained by starting the compressor at minimum capacity (25% slide valve position) .

⇒ **Note: a bypass from the discharge to the suction line will not give any benefit.**

- For the part winding motors the time delay of the run contactor should be 0.6 seconds
- For the star delta motors the time delay from star to delta connection should not exceed 1.5 seconds (suggested 1 second)

The motor stator is fixed to the compressor housing by means of a screw and a key; therefore the replacement of the motor does not require the use of any special tool.

Electrical motors are designed and tested in compliance to the European standard EN 60335-2-34.

5.2 Protection devices

5.2.1 REFCOMP RCX

The REFCOMP RCX module is available as an optional. This module carries out the following functions:

- ✓ monitors the temperature of the electrical motor and the oil;
- ✓ monitors the direction of rotation of the motor;
- ✓ monitors for a missing phase;
- ✓ monitors the occurred alarms and statistic (type of alarm, alarm time, total working hours)

The electrical connections on the REFCOMP RCX protection module are shown in pictures 5-B (PW and Star/Delta). For the technical specifications of the module see Table A in the following pages.

✓ Monitoring the temperature

The temperature of the motor and the oil are monitored by the PTC sensors. The oil temperature sensor is connected in series to the chain of thermistors in the electrical motor (for its position of the sensor on the compressor see picture 5-A). Following an alarm the control unit needs to be reset manually and the power supply has to be disconnected for at least 5 seconds.

N.B. Before re-starting the compressor following an alarm, the operator must check the temperature of the motor and the oil temperature, making sure that the resistance of the PTC chain is less than 10,9 k Ω .

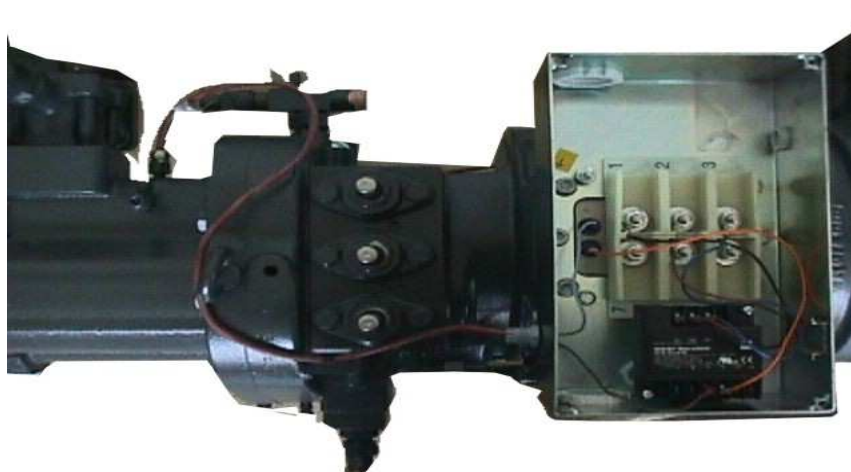
The alarm is displayed with high frequency flashing, i.e. 1 blink every second.

✓ Monitoring the direction of rotation of the motor

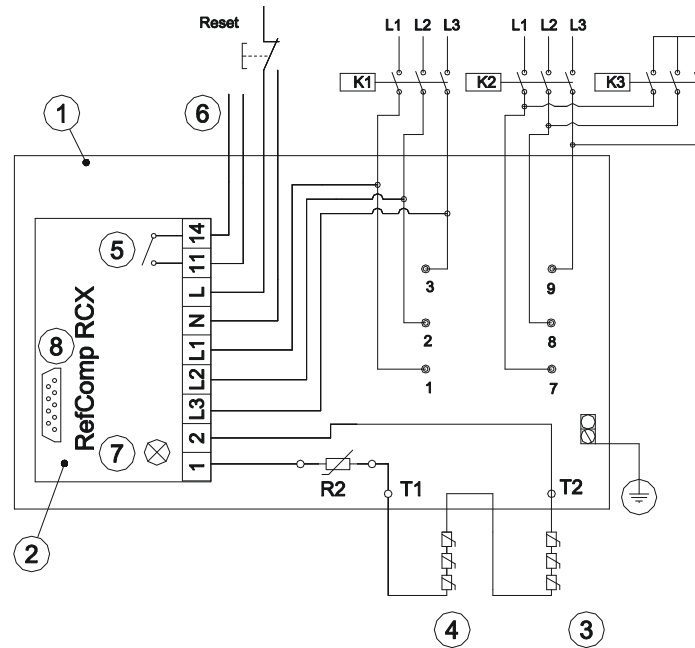
The correct direction of rotation of the motor is monitored by measuring the sequence of the phases at the compressor terminals. The function has a manual reset and requires the power supply to be disconnected for at least 5s (after correcting the sequence of the phases). The check is only performed in the first 5 seconds after starting, and not during the operation of the compressor.

✓ Monitoring for a missing phase

The phases are monitored during the start-up and, if a missing phase is detected, the compressor is stopped. The compressor restarts automatically every 5 minutes, but after 10 consecutive restarts (in the first 24 hours of working) with a missing phase the compressor is stopped definitively. After this, it must be reset manually by disconnecting the power supply for at least 2 seconds. The alarm is displayed with low frequency flashing, i.e. 1 blink every 2 or 4 seconds.



Picture 5-A: discharge gas temperature sensor with REFCOMP RCX



- 1) Terminal box
- 2) Motor protection device RefComp RCX
- 3-4) Motor thermistors PTC
- R2) Discharge gas temperature sensor
- L1-L2-L3) Power supply
- PW motor: K1 PW contactor 50%
- Y/□ motor: K2 PW contactor 50%, delay 0,6 sec.
- Y/□ motor: K1-K3 start contactors (Y)
- K1-K2 run contactors (□)
- L/N) Phase + neutral 230V-50/60Hz
- 6) Control circuit
- 1/2) Connection cables to thermistors
- 5) Relay 240V AC, max. 2,5A, C300
- 7) Led
- 8) Serial board RS232

Picture 5-B: electrical connections to the RefComp RCX module (part-winding and star delta);

Trip value	11900 Ohm
Reset value	10900 Ohm
Power supply	115/120 V or 230/240 V -15/+10%, 50/60 Hz, Absorbed power : 3VA
Output relay	1 dry contact 240V AC, max continuous switching current 2.5 A, max. switching power 300VA
Ambient working conditions (temp.)	-30°C...+60°C
Required fuse	4 A, fast type
Motor supply	200...600 V AC ±10%, 3 AC , 50/60 Hz

Table A: RefComp RCX technical specifications;

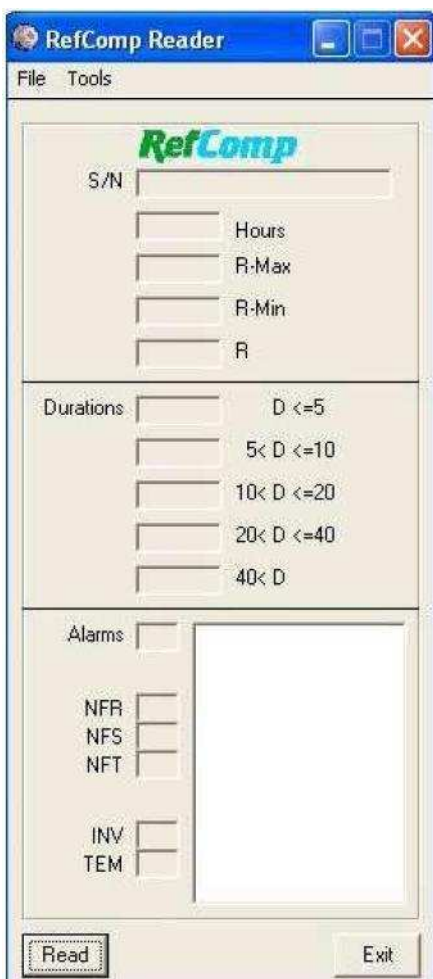
The REFCOMP RCX module is generally fitted in the compressor’s electrical box. However it can be moved and fitted in a main control box far away from the compressor according to the following indications:

- ✓ The connection cables to the motor terminals must be connected following the specified sequence: L1 to terminal 1, L2 to terminal 2 and L3 to terminal 3; **check the direction of rotation with an indicator;**
- ✓ To connect the module to the PTC sensors, only use shielded cables or a twisted pair (danger of induction);

Trough the serial port RS232 in the module, is possible to read the occurred alarms , connecting the module to the PC with a proper serial cable (not included in the standard delivery).

	<p>Warning!</p> <ul style="list-style-type: none"> ✓ In order to read the module, the compressor has to be stopped. The module has to be supplied trough the terminals L,N (see picture 5-F) ✓ If the module is not read on the compressor, be sure to provide a bridge between electrical terminals 1 and 2 in order to not interrupt the PTC chain. This would add a thermal alarm to the total amount of them.
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Description of RCX Reader Interface



- S/N : Show the registered serial no. of the compressors
- Hours : Indicate the running time of the compressor
- R max : Indicate the cut-off resistance limit
- R min : Indicate the cut-on resistance limit
- R : Indicate the PTC chain instant resistance
- D <=5 : Indicate the no. of running intervals below 5 min.
- 5 < D <=10 : Indicate the no. of running intervals between 5 and 10 min.
- 10 < D <=20 : Indicate the no. of running intervals between 10 and 20 min.
- 20 < D <=40 : Indicate the no. of running intervals between 20 and 40 min.
- 40 < D : Indicate the no. of running intervals bigger than 40 min.
- Alarms : count the total amount of alarms encountered
- NFR : count the no. of phase loss alarms encounterd on phase R
- NFS : count the no. of phase loss alarms encounterd on phase S
- NFT : count the no. of phase loss alarms encounterd on phase T
- INV : count the no. of phase reversal alarms encounterd
- TEM : count the no. of cut-off resistance limit

Picture 5- C: Explicit interface screen of RCX Reader

	<p>Warning!</p> <ul style="list-style-type: none"> ✓ The RCX module is uniquely associated to serial number of compressor ✓ It is strictly forbidden by the customer to remove or tamper with the RCX module from the compressor ✓ Refcomp reserves the right not to recognize a guarantee of the compressor if the RCX module has been removed or tampered with.
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5.2.2 Oil flow switch and INT 69 VS

The correct operation of the lubrication circuit is constantly monitored by an oil flow switch fitted in the oil line between the oil separator and the compressor. This device is controlled by the protection module INT 69 VS, delivered as a standard together with an electrolytic condenser.

Legend

A1:	Oil thermostat
C1:	Electrolytic condenser
FA:	Main fuse
FB:	Compressor fuse
FD:	Control circuit fuse
FO:	Oil flow switch
H1:	Signal lamp oil flow fault
H2:	Signal lamp motor fault (overheating discharge gas temp, inverse rotation, phase failure).
H3:	Signal lamp oil level fault
HP:	Pressostat high pressure.
I1:	Main switch
INT 69 RCY:	Protection device for motor protection and discharge gas superheat protection
INT 69VS:	Control device for oil flow monitoring
K1:	Contactors first winding
K2:	Contactors second winding
LP:	Pressostat low pressure
M1:	Compressor
OL:	Oil level
P1:	Fault reset
R1:	Time relay oil flow control
R1T:	Time relay oil level control
R2T:	Time relay start delay.
R3T:	Time relay part winding start
R4:	Auxiliary contactor
RE:	Crankcase heater
RT1:	Time relay oil flow fault.
S1-6:	PTC motor windings
S1:	On-off switch
STS:	Discharge gas temperature sensor
T:	Control thermostat
TH1:	Relay overcharge first winding
TH2:	Relay overcharge second winding
Y1:	Solenoid valve oil injection
Y2:	Solenoid valve condensed liquid

Schematic wiring diagrams

The following schematic diagram contains both the protection devices and INT69 VS (oil flow control) and their connections:

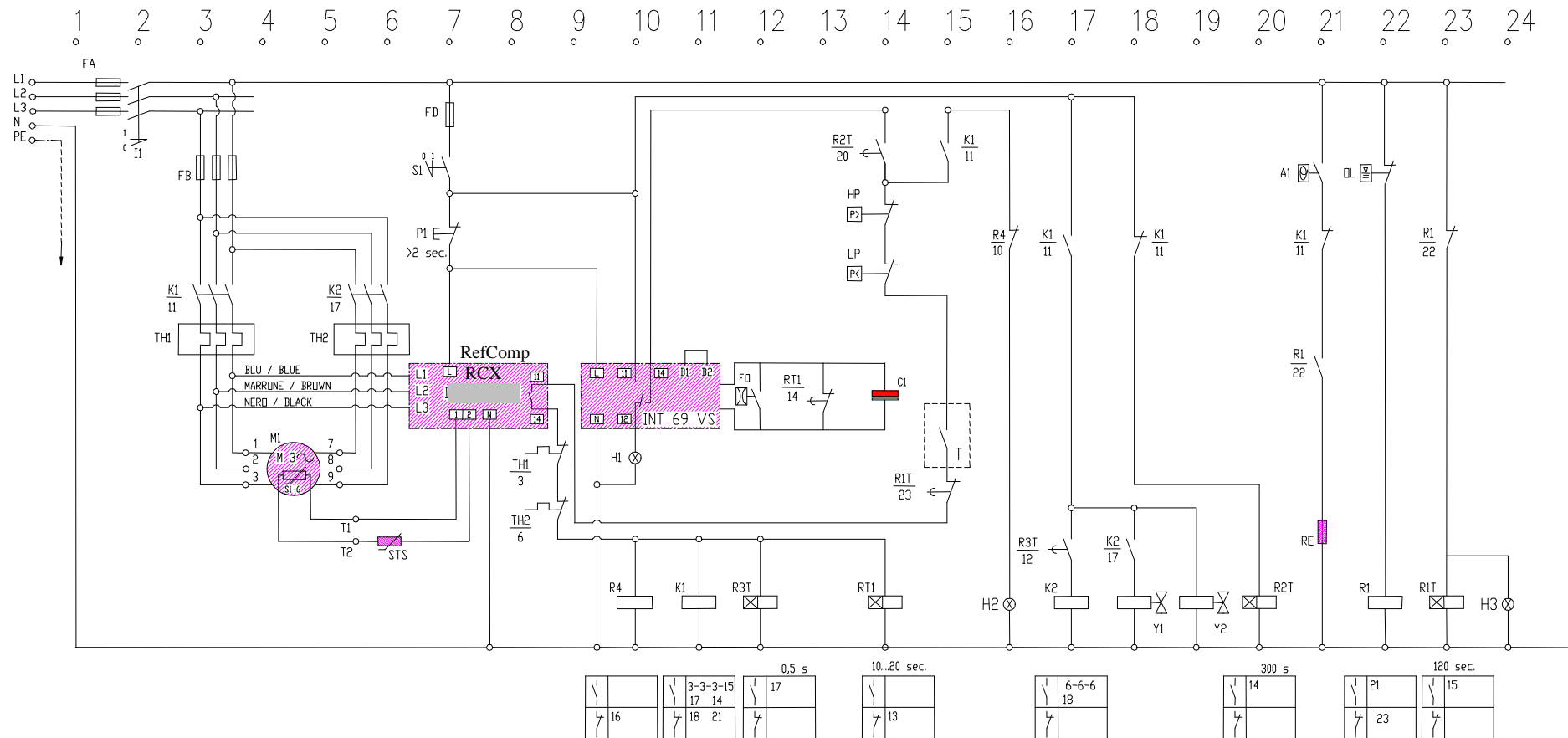




Figure 5-D: Schematic wiring diagrams

5.3 Power supply

	<p>Attention!</p>  <p>For the direction of rotation of the rotors see chapter SA-01: “General”. If the motor turns in the opposite direction the compressor can be seriously damaged.</p>
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- Motor power supply for standard version (part winding and star delta):
400 V - 3 phases - 50 Hz / 460 V phases - 60 Hz (other power supply on request)
- Permissible voltage range: $\pm 10\%$ of rated voltage
- Permissible voltage unbalance between L1 - L2 - L3: $\pm 2\%$
- Maximum voltage drop during the starting phase: 10 % of rated voltage
- Permissible frequency range: $\pm 2\%$ of rated frequency
- Permissible current unbalance: 5 /12 % calculated as follows:

Currents on the first contactor: $I_1 - I_2 - I_3$

Currents on the second contactor: $I_7 - I_8 - I_9$

Currents of each supply phase:

$$I_R = I_1 + I_7$$

$$I_S = I_2 + I_8$$

$$I_T = I_3 + I_9$$

Unbalance of the three R - S - T currents:

$$I_M = \frac{I_R + I_S + I_T}{3}$$

$$SB_3\% = \frac{\text{MAX}(I_R, I_S, I_T) - I_M}{I_M} \cdot 100$$

$$SB_3\% < 5\%$$

Unbalance of the six 1 - 2 - 3 - 7 - 8 - 9 currents:

$$I_M = \frac{I_1 + I_2 + I_3 + I_7 + I_8 + I_9}{6}$$

$$SB_6\% = \frac{\text{MAX}(I_1, I_2, I_3, I_7, I_8, I_9) - I_M}{I_M} \cdot 100$$

$$SB_6\% < 12\%$$

5.4 Selection of electrical components

The size of cables, fuses and contactors should be selected considering the Full Load Ampere (FLA) and not the nominal motor power. Contactors should be sized for at least 65% of the FLA. On the other hand, for the star-delta configuration the contacts must be sized for a current equal to at least 75% of the FLA.

5.5 Electrical data: SW series

Compressor model SW1H Compressore modello SW1H		4000	5000	6000	7500	9000	10500	11500	12500	14000	16000	19000	21000	24000	25000
Nominal motor power Potenza nominale motore	Hp/kW	40/30	50/37	60/45	75/55	90/67	105/78	115/89	125/89	150/110	170/125	200/147	220/161	240/176	240/176
Standard motor ⁽¹⁾ Motore standard ⁽¹⁾		400V/3/50Hz - 460/3/60Hz													
PW (50/50) Starting current PW/DOL PW (50/50) Corrente di spunto PW/DOL	A	277/398	303/406	373/547	280/459	351/580	652/1015	646/953	646/953	-	-	-	-	-	-
Star/Delta Starting current Star/DOL Star/Delta Corrente di spunto Star/DOL	A	131/398	134/406	182/547	159/459	193/580	338/1015	318/953	318/953	354/1155	374/1155	453/1333	543/1645	595/1802	595/1802
Max running current Massima corrente di funzionamento	A	65	82	96	124	140	168	182	196	185	200	220	250	270	300
Compressor model SW1L Compressore modello SW1L		3000	4000	5000	6500	8000	9500	10500	11500	13000	15000	17000	20000	22000	23000
Nominal motor power Potenza nominale motore	Hp/kW	30/22	40/30	50/37	65/48	80/60	95/71	105/78	115/89	120/88	150/110	170/125	200/147	220/161	220/161
Standard motor ⁽¹⁾ Motore standard ⁽¹⁾		400V/3/50Hz - 460/3/60Hz													
PW (50/50) Starting current PW/DOL PW (50/50) Corrente di spunto PW/DOL	A	227/331	277/398	303/406	262/422	280/459	405/670	646/953	646/953	-	-	-	-	-	-
Star/Delta Starting current Star/DOL Star/Delta Corrente di spunto Star/DOL	A	110/331	131/398	134/406	139/422	159/459	223/670	318/953	318/953	276/876	354/1155	374/1155	453/1333	543/1645	543/1645
Max running current Massima corrente di funzionamento	A	55	65	75	87	106	130	142	154	225	245	270	300	334	380

⁽¹⁾ Voltage tolerance $\pm 10\%$

⁽²⁾ Preliminary value

Standard motor

5.6 Electrical data: SRC-W series

Compressor model SRC-WS Compressore modello SRC-WS		40	50	60	70	80
Nominal motor power Potenza nominale motore	Hp/kW	40/30	50/37	60/45	70/52	80/60
PW (50/50) Starting current PW/DOL PW (50/50) Corrente di spunto PW/DOL	A	277/398	303/406	373/547	280/459	351/580
Star/Delta Starting current Star/DOL Star/Delta Corrente di spunto Star/DOL	A	131/398	134/406	182/547	159/459	193/580
Max running current Massima corrente di funzionamento	A	80	82	96	124	140

Compressor model SRC-WL Compressore modello SRC-WL		30	40	50	-	-
Nominal motor power Potenza nominale motore	Hp/kW	30/22	40/30	50/37	-	-
Standard motor ⁽¹⁾ Motore standard ⁽¹⁾		400V/3/50Hz - 460/3/60Hz				
PW (50/50) Starting current PW/DOL PW (50/50) Corrente di spunto PW/DOL	A	277/398	303/406	373/547	-	-
Star/Delta Starting current Star/DOL Star/Delta Corrente di spunto Star/DOL	A	110/331	131/398	134/406	-	-
Max running current Massima corrente di funzionamento	A	65	80	88	-	-

⁽¹⁾ Voltage tolerance $\pm 10\%$ / tolleranza sul voltaggio \pm

⁽²⁾ Preliminary value / valori preliminari

Standard motor / Motore standard